ALE for converging flows

A. Burbeau, JF. Clouet and B. Roche

Monday, September 23, 2002

The goal of ICF simulations is to design DT-CH targets to reach ignition (nuclear combustion with gain). The highest values of the gain are achieved with isotropic compression of the target. Such a compression induces a 1-D spherical flow with a high compression ratio in the target. Correct simulation of these features are two of the main difficulties when devicing numerical scheme. But these points are only a first step : real geometry of the cavity rarely produces fully isotropic flows. So the numerical scheme must also be able to treat arbitrary flows.

In a purely lagrangian ICF simulation, large mesh distorsions can result in severe degradation of accuracy and robustness. So complementary tools are needed to help the scheme to handle these difficulties. This paper will focus on some of the tools used in our 2D ALE hydrocode for the computation of DT-CH targets.

The first one is a set of velocity corrections which suppress the hourglass-type motions. But in the particular case of isotropic flows using polar meshes, these algorithms may also perturb the one-dimensional flow and alter the yield. A new method, well adapted to isotropic flows, has been tested and is now presented.

In the second part, and ALE methodology is used to improve robustness of ICF simulations. Most of grid regularization algorithms are based on geometric criterions. They are used to reduce mesh distorsions, but they have to take into account the physics of the flow for good accuracy of the results. The difficulty is to balance the geometric and physical thresholds. We illustrate the properties of various grid regularization algorithms using a non-symetric implosion test case. Corrections to existing algorithms are proposed, based on a local choice of the coordinate system, and on the use of a variable weighted function.